REMARKS

Claims 1 through 5 and 7 through 63 are currently pending in the application.

Claims 33-57 are withdrawn from consideration as being directed to a non-elected invention.

Claims 1 through 5, 7 through 32 and 58 through 63 currently stand rejected.

Claim 9 has been amended in this amendment.

This Amendment is in response to the Final Rejection in the Office Action of August 1, 2002.

35 U.S.C. § 112 Rejections

In the Office Action, claim 9 was rejected under 35 U.S.C. § 112 second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicant regards as the invention. Applicant has amended the claim language "a material for increasing the surface tension to one of said surface of said semiconductor device and said surface of said substrate" to clarify and to state that the increase is relative to the wetting capability of the original material.

35 U.S.C. § 102(e) Anticipation Rejections

Claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 were rejected under U.S.C. § 102(e) as being anticipated by Dery et al., (United States Patent 6,074,895).

Applicant submits that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. Of California*, 2 USPQ2d 1051, 1053 (Fed. Cir.1987). The identical invention must shown in the same complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir.1989).

Dery et al. describes a method of forming a flip-chip on board assembly. A flip-chip 110 with a passivation layer 111 of polyimide or other material is attached to a chip carrier 120 which may have an epoxy resin solder mask surface 124 with inorganic filler particles (see col. 3, lines 46-57 and col. 4, lines 11-15). A gaseous plasma is used to treat the chip 110 in order to oxidize

and microroughen the surface of passsivation layer 111 (see col. 4, lines 1-8). The surface 124 of chip carrier 120 may also be roughened by the gaseous plasma or by mechanical means (see col. 4, lines 36-60). An encapsulated material 140 is then used to underfill the space between the flip-chip 110 and chip carrier 120. The plasma treatment is believed to enhance adhesion between the filler and the chip surface and chip carrier (see col.1, lines 21-34).

Independent claims 1, 10 and 58 of the present application recite an element of the invention calling for "applying a wetting agent layer" to one of a semiconductor surface and a substrate surface. Dery et al. expressly teaches using a gaseous plasma to chemically and physically alter existing chip passivation layer 111 and chip carrier surface 124 to improve adhesion and reduce the incidence of delamination (see col. 2, lines 51-64). The instant invention is directed to the application of a wetting agent layer which implies that the material being applied is in either solid or liquid form and capable of being applied. Dery et al. does not discuss applying a wetting agent layer to any surface of either the flip-chip or the substrate. Therefore, Applicant respectfully submits clams 1, 10 and 58 are allowable over Dery et al. under 35 U.S.C. § 102(e). Claims 2, 4, 5, 7, 11, 12, 15, 22, 59, and 60 are allowable as depending from independent claims 1, 10 and 58.

Additionally, Dery et al. fails to anticipate under 35 U.S.C. §102(e) the elements of the invention found in claims 4 and 59 setting forth "applying said wetting agent layer comprises any one of a dispensing method, a brushing method, and a spraying method". Furthermore, Dery et al. fails to anticipate under 35 U.S.C. §102(e) in claim 7 the element of the invention calling for "wherein said wetting agent layer comprises a plurality of layers" and in claim 9 the element of the invention calling for "applying said wetting agent layer comprises providing a material for increasing the surface tension relative to one of said surface of said semiconductor device and said surface of said substrate". Applicant submits that Dery et al. merely modifies an existing passivation layer and is limited to devices which have such a layer.

35 U.S.C. § 103(a) Obviousness Rejections

Applicant submits that to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 three basic criteria must be met. First, there must be some suggestion or motivation, either

in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the cited prior art reference must teach or suggest all of the claim limitations. Furthermore, the suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on the Applicant's disclosure.

Claims 3, 8, and 61 through 63 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Dery as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 and further in combination with Plueddemann (United States Patent 4,231,910). Applicant respectfully submits this combination fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103.

Applicant submits that Plueddemann teaches a primer composition for improving adhesion between a thermoplastic and a substrate. The composition consists essentially of 1 to 25 weight percent of an organosilicon compound selected from a group of silane compounds or partial hydrolyzates of silane and 75 to 99 weight percent of an alkoxymethyltriazine (see col. 2, lines 5-17). Plueddemann is directed only toward improving adhesion of thermoplastic materials on substrates. Thus Plueddemann is directed only at thermoplastics. Applicant submits that there is nothing in the cited references or from the knowledge generally known to those working in the art that would motivate one of ordinary skill in that art to combine the teachings of Plueddemann with the invention of Dery et al.

Applicant submits that Dery et al., is specifically directed to semiconductor manufacturing, while Plueddemann is drawn toward preparing a specific chemical composition. Plueddemann does not mention applying the inventive compound to manufacturing processes such as the semiconductor process in Dery et al. In the Office Action it was asserted that because both processes are drawn to the improvement of adhesion of plastic, it would be obvious to combine the two. However, "The mere fact that the prior art may be modified in the manner suggested does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Gordon*, 733 F.2d at 902, 221 USPQ at 1127 (Fed. Cir. 1984)(at 1783). There is nothing in either reference to indicate using the composition of Plueddemann in

place of, or in combination with, the gaseous plasma of Dery et al. would provide any desirable improvement to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed invention. In fact, there is no reasonable expectation that this modification would succeed. Plueddemann teaches a composition for improving adhesion between a *solid substrate* and a *thermoplastic*. Plueddemann does not contemplate adhering a liquid underfill encapsulant or adhering to an epoxy resin solder mask such as those described in Dery et al. At best, the combination would be obvious to try, which does not meet the standard for establishing a *prima facie* case for an obviousness rejection under 35 U.S.C. § 103. Therefore, Applicant respectfully submits the combination is an attempt to piece together the subject matter required by the claims which could only be motivated by the benefit of the hindsight provided by the Applicant's disclosure.

Accordingly, Applicant respectfully submits a *prima facie* case of obviousness under 35 U.S.C. § 103 has not been established. Therefore, claims 3, 8, and 61 through 63 are allowable under 35 U.S.C. § 103(a).

Claims 13, 14, 16 through 21 and 23 through 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Dery et al. as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 supra, and further in combination with Akram (United States Patent 5,766, 982).

Applicant submits that Akram et al. teaches an apparatus and method for underfilling an area between a semiconductor substrate 10 and a flip-chip 12 (see col. 2, lines 52-54). Akram teaches that underfilling may be accomplished by filling from an opening 60 near the center of substrate 10, while the substrate and semiconductor assembly is inclined, and with the assistance of a vibrating device 48 (see col. 2, lines 60-64, col. 5, and col. 6 lines 34-61).

Applicant submits that there is no motivation to combine the teachings of Dery et al. with Akram et al. to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 because the references teach away from the method of the instant invention. Akram et al. advocates a method which is cost reducing and which utilizes standard substrates. The emphasis in Akram is on reducing the steps required and consequently the expense of production. In contrast, Dery et al., teaches that the passivation layer 111 and substrate surface 124, must be chemically and physically altered by exposure to a gaseous plasma. As a result, the process of Dery et al.

requires the expense of additional equipment. Therefore, Dery et al. is a more expensive process. Applicant respectfully submits that it "is improper to combine references where the references teach away from their combination." M.P.E.P. § 2145(X)(D)(2)(citing *In re Grasselli.* 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir.1983)).

The cited references, either alone or in combination, also fail to teach or suggest all of the claim limitations to establish a *prima facie* case of obviousness under 35 U.S.C.§ 103. As discussed above, Dery et al. does not teach or suggest the limitation of "applying a wetting agent layer" recited in independent claims 1 and 10. Rather, Dery et al. uses a gaseous plasma to chemically and physically alter the existing chip passivation layer and chip carrier surface. Akram et al. does not utilize any kind of wetting or adhesion improvement, and combining it with Dery et al. does not overcome the limitation of "applying a wetting agent layer". Claims 13, 14, 16-21 and 23-30 depend from independent claims 1 and 10. If an independent claim is nonbvious under 35 U.S.C. §103, then any dependent claim is also nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir.1988).

Claims 31 and 32 were rejected under 35 U.S.C. §103(a) as being unpatentable over Dery as applied to claims 1, 2, 4, 5, 7, 10 through 12, 15, 22 and 58 through 60 supra, and further in view of Banerji et al. (United States Patent 5,203,076).

Claims 31 and 32 depend from independent claim 10 which recites the limitation of "applying a wetting agent layer". For the same reasons as described above, Applicant submits that neither Dery et al nor Banerji et al. teach or suggest this claim limitation. Claims 31 and 32 are therefore allowable under 35 U.S.C. § 103(a) as depending from claim 10.

In the Office Action, it was asserted that while Dery et al. does not explicitly teach "applying a wetting agent layer" by inferring that the agent layers 111 and 124 in Dery et al. performed the same function, "the layers 111 and 124 are substances that, by becoming absorbed, prevent the device 110 and substrate 120 surfaces from being repellent ["enhance adhesion"]". Applicant respectfully replies that surfaces which are merely prevented from repelling one another is a different objective from "improving adhesion". The wetting agent layer is designed to allow a liquid to flow freely and evenly over the surface to which the liquid is applied. In contrast, repellent prevention may merely mean that the surfaces may be brought into close

proximity with no adverse reaction. Furthermore, in the Office Action the nature of the layers 111 and 124 are mischaracterized. Layer 111 is a passivation layer, which is an inherent part of the integrated circuit surface at the completion of the circuit manufacturing process. It is not added to facilitate the flip-chip bonding process. Thus, layer 111 cannot be a "wetting agent layer'. Layer 124 is the surface of a chip carrier, also an inherent part of the structure of a chip carrier. As described in Dery et al. at col. 4 lines 12-15 "the surface 124 of the chip carrier 120 comprises an epoxy resin solder mask having inorganic filler particles." Layer 124 is merely the surface of the chip carrier prepped for chip carrier assembly with a solder mask. Thus, the Examiner mischaracterizes layer 124 when describing it as a "wetting agent layer".

In the Office Action it is asserted that the purpose of the "wetting layers" in Dery et al is to reduce the contact angle of the underfill material. Respectfully, Applicant submits that this is not an accurate characterization of Dery et al. Rather, Dery et al. teaches that the purpose of the plasma treatment of the passivation layer of an integrated circuit and chip carrier surface is to reduce the contact angle of the underfill material. Applicant submits that it is the gaseous plasma treatment which acts on the inherent surfaces of the integrated circuits and chip carriers in Dery et al. which achieves the desired reduction in contact angle of the underfill material.

In addition in the Office Action it is argued that there is motivation to combine the processes of Dery and Plueddeman because "the process of Plueddeman would improve the adhesion of the plastic of Dery". Applicant respectfully suggests that the combination is not properly suggested by the references because applying the primer of Plueddeman to a surface micro-roughened by the gaseous plasma of Dery would cover the surface and eliminate the benefit of using the process of Dery. Thus, there is no reasonable expectation of success in making this modification. "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Gordon*, 733 F.2d at 902, 221 USPA at 1127 (Fed. Cir.1984). Thus, it appears that this combination is a hindsight reconstruction of the claimed invention which could only be motivated by hindsight provided solely by the Applicant's disclosure.

In the Office Action it is argued that Akram (United States Patent 5,766,982) cannot be traversed as Applicant argues because Akram does not define or describe the meaning of the phrase "additional equipment" and the scope of the language cannot be determined. Applicant respectfully suggests that the meaning of the phrase "additional equipment" as intended in Akram may be determined by reviewing the specification of Akram. Specifically, Akram describes the usual process of underfilling at col. 1, lines 46-58. The specification then proceeds to discuss other methods as defined in two additional patents, Liu (United States Patent 5,385,869) and Banerji (United States Patent 5,203,869). Liu requires the installation of gates or notches on the chip and thus requires the equipment to install or create the gates and/or notches. (Akram, United States Patent 5,766,982 col. 2, lines 6-19). Banerji utilizes a vacuum chamber to improve the capillary action. (Akram, United States Patent 5,766,982 col. 2, lines 20-30). Since the standard process merely uses unassisted capillary action while the method of Banerji adds a vacuum chamber, it may be concluded that the method of Banerji requires additional equipment. Dery requires a plasma chamber to expose the areas to be treated to the gaseous plasma. Thus, Dery requires additional equipment. It would not be obvious to combine Dery and Akram since Dery requires additional equipment, specifically a plasma chamber, and Akram teaches away from using additional equipment.

Applicant submits that claims 1 through 5, 7 through 32, and 58 through 63 are clearly allowable over the cited prior art for the reasons set forth above.

Applicant requests entry of this amendment for the following reasons:

The amendment clearly places the application in condition for allowance.

The amendment is timely filed.

The amendment does not require any further search or consideration.

The amendment reduces the number of issues for any subsequent appeal of the Final Rejection.

In summary, Applicant requests entry of this amendment, the allowance of claims 1 through 5, 7 through 32, and 58 through 63, and the case passed for issue.

Respectfully submitted,

James R. Duzan

James R. Duzan
Attorney for Applicant
Registration No. 28,393
TRASKBRITT, PC
P.O. Box 2550
Salt Lake City, Utah 84110
(801) 532-1922

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JRD/RAY:djp

Enclosure: Version with Markings to Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

A marked up version of each of the presently amended claims, highlighting the changes thereto, follows:

9. (Three times Amended) The method according to claim 1, wherein said applying said wetting agent layer comprises providing a material for increasing the surface tension relative to one of said surface of said semiconductor device and said surface of said substrate for the application of an underfill material.